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LIST OF SUGGESTED BIDDERS

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Edison O&M Services
Attn: Carlos Alcaino
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PART F - DIVISION F2

DETAILED SPECIFICATIONS - DETAILED REQUIREMENTS

1. General: This division contains the detailed requirements for the **Turbine Cycle Performance Testing** as required by IPSC for the Intermountain Generating Station Units 1 and 2.

   a. Plant Description: INTERMOUNTAIN GENERATING STATION
   Two sister 875 MW gross units
   IGS Unit 1 commercial 6/86
   IGS Unit 2 commercial 5/87

   b. Turbine Design Information: General Electric S-2, tandem-compound, single reheat with six-flow low pressure stages. The turbine consists of:

   HP Turbine: newly replaced (U2 - 03/2002, U1 - 03/2003) Alstom single flow, with full arc admission
   IP Turbine: double flow reheat
   LP Turbines: Three (3) double flow low pressure sections with 30-inch last stage buckets

   Rated Operating Conditions:
   VWO/2400psig/1000F/1000F/6,900 kpph/977 MW gross
   Variable Back pressure of 1.66" Hga/2.24" Hga/2.99" Hga

   Stop Valves (4)
   Control Valves (4) full arc admission control
   Combine reheat stop and intercept valves (2)
   Each SV and RSIV have associated steam strainers

   Condensers: Three (3) Variable Pressure Condenser Hoods
   Feedwater Heaters: Dual string of three (3) high pressure FW heaters (8A/8B, 7A/7B, & 6A/6B)
   LP FW Heater String (deaerator, 4, 3, 2, 1A/1B/1C, DC)

   Pumps/BFPT: Two (2) Boiler Feed Pumps, two (2) Boiler Feed Pump Turbines, three (3) Booster Boiler Feed Pumps, three (3) Condensate Pumps

2. Standards and Codes: Performance testing shall be done in accordance with the following American Society of Mechanical Engineers (ASME) Performance Test Code (PTC), unless where otherwise stated in these specifications, as stated in the Test Procedure or as mutually agreed upon.

ASME PTC 6 - 1996 Steam Turbines, alternative test method utilizing the high pressure primary feedwater flow element.

3. Scope of Work: The Intermountain Power Service Corporation (IPSC) is upgrading plant performance and capacity by replacing the high pressure (HP) turbine section. Performance testing shall be conducted on the HP Turbine and turbine cycle following the Intermountain Generating Station (IGS) Unit 1 and 2 Major Outages.

   a. The objective of the HP turbine acceptance testing is to determine the HP turbine efficiency (enthalpy drop test) and HP Wheel Power (electrical load equivalent produced by the HP turbine). This information is required to determine HP turbine contract penalties and incentives.

   b. In addition to testing the HP turbine for acceptance, the performance tests shall be used for benchmarking the performance of other key turbine cycle components. These key components include: the IP turbine (following its outage overhaul), retractable steam packing on HP & IP turbine, boiler feedpump volute acceptance (following outage changeout), and boiler feedpump turbines (detailed performance evaluation).

   c. All station instrumentation points shall be cross checked and reconciled with third-party instrumentation. High accuracy instrumentation is critical to establish several key relationships;

      (1) HP Turbine Bowl Pressure (1st stage pressure tap replacement) to throttle steam flow for turbine controls setup.

      (2) Final feedwater flow to throttle flow relationship (for controls as well as monitoring steam flow for safety valve limitations).

      (3) Generator electrical output.

4. Contractor/ IPSC Liaison: Contact between the Contractor and IPSC for coordination, assignment of tasks, exchange of technical information, and interface shall be maintained through the IPSC Contract Administrator.

   The IPSC Contract Administrator for this contract will also be the "Test Coordinator" and will coordinate testing with IPSC Operations Department and will act as interface with Alstom, the HP turbine supplier.

5. Testing Requirements:

a. Plant Operation: The IPSC Test Coordinator will coordinate testing with IPSC Operations Department.

The Operations Department will take any action needed to maintain safety and reliability, during the course of a test. The Test Coordinator will immediately advise test personnel of any changes to the operating conditions or plant isolation.

b. Number and Duration of Tests: The total number of tests in the series is six (6). Each test is to last a minimum of two (2) hours. Stable test conditions must exist for a minimum of one (1) hour prior to the test.

For the HP Turbine testing, two (2) VWO (valves wide-open) performance tests shall be carried out. The tests shall be compared for repeatability. Repeat tests shall be conducted if the results are inconsistent.

TEST SERIES (6):

Full Load Tests	(2)	@ VWO/ 2400 psig/ Load 975 MWg
96% Load Tests	(1)	@ VWO/ 2300 psig/ Load 930 MWg
92% Load Tests	(1)	@ VWO/ 2200 psig/ Load 890 MWg
87% Load Tests	(1)	@ VWO/ 2100 psig/ Load 850 MWg
95% Load Test	(1)	throttled/ ~2300 psig/ Load 925 MWg

c. Frequency of Readings: Pressure and temperature readings shall be automatically logged at intervals no greater than one (1) minute.

d. Valve Isolation List: IPSC shall produce a Valve Isolation List to identify the valves requiring closure for the turbine test. These identified valves, shall then be closed or checked by IPSC Operations personnel prior to the test.

To reduce or eliminate unmeasurable leakage rates, drum blowdown, auxiliary steam supply, and sootblowing steam supply shall be isolated for the two (2) hour test period.

To quantify leakage rates from unknown sources (such as leaking drains and isolation valves), condenser makeup to the hotwell shall be isolated during the test and drop in hotwell monitored and measured to calculate losses. The major leakage sources shall try to be identified with walkdowns measuring downstream temperatures of isolation and drain valves.

Depending upon the magnitude of the cycle leakage (target is less than 0.25 percent) and whether a leakage source can be identified, a test may be rerun with additional valve isolation to determine the impact the leakage has on turbine output and cycle heat rate.

e. Data Reduction: Test data shall be averaged and corrected for instrumentation calibrations, water legs, zero readings, barometric pressure, and ambient temperature. Steam and water enthalpies shall also be determined and flow rates calculated.

Flow rate is proportional to the square root of the pressure differential across a measuring device. The reduction of differential pressure data should therefore be based on the average of the square root of the readings.

f. Posting Diagram: Pertinent data from the station computer relevant to the turbine cycle shall be downloaded by IPSC from the Plant Data Acquisition System to an MS Excel spreadsheet. These values shall be averaged for the testing period. Measured values and the station data shall then be posted on a turbine cycle diagram.

g. Steam Tables: The 1997 ASME steam tables shall be used in the calculation of the test results.

h. Calculation of Results: Test data shall be evaluated as quickly as possible to determine validity of the test results. This evaluation shall help determine the cause of any problem such as inaccurate or inadequate instrumentation or possibly a test set-up issue.

The performance of the turbine test cycle shall be calculated from the measurement points provided to the turbine cycle test posting diagram.

Performance calculations shall include but not be limited to the following:

Turbine Cycle Heat Rate
HP turbine efficiency (enthalpy drop test)
HP Wheel Power (electrical load equivalent)
IP turbine efficiency (enthalpy drop test)
Retractable steam packing on HP & IP turbine
Boiler feedpump performance
Boiler feedpump turbines performance

IPSC has developed and will be using a computerized heat balance diagram modeled for the turbine cycle using ScienTech's PEPSE software to check all calculations.

i. Corrections of Test Results for Load and Heat Rate to Specified Conditions: Since operating conditions cannot be maintained at target values, it is necessary to correct test performance for these deviations using the methods outlined in the ASME PTC 6 Steam Turbine, utilizing the alternative method. This shall assure comparison of the results of the test on the turbine with the specified performance on the basis of an equivalent cycle.

Group 1 Corrections (for load and heat rate): Final feedwater temperature correction (due to top heater TTD or extraction pipe pressure drop different from specified heat balance.)

Extraction Steam to BFPT
Main steam desuperheating spray
Reheat steam desuperheating spray
Condenser - condensate subcooling
Condenser Makeup

Water Storage Changes (hotwell, DA, drum, etc.)
Power factor
Generator hydrogen pressure
Generator voltage

Group 2 Corrections (for load and heat rate):
Throttle pressure
Throttle temperature
Hot reheat temperature
Reheat Pressure Drop
Turbine Back pressure

The detailed calculation methods for the various tests are referenced on the calculation sheets in Appendix III of this procedure.

j. Measurement Uncertainty: Post-test measurement uncertainty analysis shall be calculated utilizing the high accuracy instrumentation and the station instrumentation available.

6. Services Provided by IPSC: IPSC will provide test coordination and technical direction.

a. Instrumentation Support: IPSC will provide Instrumentation and Control (I&C) Technician support to connect pressure instrumentation to the test point root valves.

IPSC will be responsible for opening the isolation valves going to the test point root valves. IPSC will blow down instrumentation lines prior to the test to verify they are free of obstructions.

IPSC will inspect (and repair if necessary) the installed turbine exhaust basket tips.

IPSC will provide stainless tubing and Swagelock fittings to plumb pressure and differential pressure instrumentation.

Water leg correction heights shall be provided for the pressure test points.

Atmospheric pressure shall be measured using a precision barometer.

IPSC will inspect and clean temperature thermowells with a stainless steel brush to remove rust and any debris.

b. Maintenance Support: IPSC will inspect and clean the HP Feedwater Flow nozzle and the Main Steam Desuperheating Spray nozzle during the outage.

IPSC will also inspect, clean, and install the BFPT Extraction Steam Flow nozzle spool piece and flow straightener during the outage.

Calibration test reports for the primary feedwater flow nozzle, main steam desuperheating spray nozzle, and the BFPT extraction steam flow nozzle shall be provided.

c. Electrical Support: IPSC shall provide Electrician support to hook up the electrical power output measurement.

d. IPSC shall also provide the following:

(1) Access to the test areas, which includes scaffolding, moveable platforms or ladders.

(2) Insulation removal and replacement.

(3) 110 volt AC power.

(4) General lighting for the test areas.

(5) Office space.

(6) Vehicle parking in designated areas.

7. Services and Equipment Provided by Contractor: The Contractor shall furnish precision instrumentation, precision test equipment, data acquisition system (DAS), DAS wiring

and power cords, materials, instrument calibrations, test equipment calibrations, setup services, data collection and reduction, performance calculations and all other requirements to perform the Contract in accordance with the specifications.

a. The Contractor shall provide personnel specifically trained and experienced in performance testing of steam turbines, for handling and setting up high precision instrumentation and for interfacing the instrumentation with a data acquisition system for automated collection.

b. The Contractor shall provide calibrated precision instrumentation and test equipment as requested in Attachment III.

c. All instrumentation and test equipment shall be hooked into a data acquisition system (DAS) providing all interface wiring and power cables to allow automated collection of data.

d. The Contractor shall provide computerized data reduction and analysis of the test results. The contractor shall provide the Calculation of Results as outlined in Section 5, paragraph h, applying correction of the test results to specified conditions.

e. The Contractor is encouraged to offer suggestions for improvements in scope of work and test methods that may yield better results.

f. Interface: An entrance meeting is required before the start of work to review the scope and test procedures. An IPSC Safety Orientation class (2 hours) is required for all Contractor employees to review IPSC Safety Procedures.

Status meetings on work progress and results shall be held with the Test Coordinator at the beginning of each day and as necessary throughout the test period. Routine interface with the Test Coordinator is crucial. Dialog should include instrumentation and Data Acquisition System status, plus highlighting testing concerns or issues.

An exit meeting and preliminary report shall be given to the Test Coordinator prior to the Contractor leaving the site.

g. All work shall be performed to the satisfaction of the IPSC Project Coordinator.

8. Test Instrumentation and Equipment Requirements: A Test Instrumentation and Equipment List of the third party equipment is attached in an Appendix. The Contractor shall also provide adequate spares of test instrumentation, test equipment, and parts in the event of poor agreement of redundant points, questionable data or instrument failure.

a. Pressure Measurement: High precision pressure transducers are to be calibrated to within 0.1 percent accuracy. They may measure either gauge or atmospheric pressure. All measured pressures shall be corrected for static water legs, atmospheric pressure, and instrumentation calibrations.

Several pressure test points may be multiplexed to one precision transducer through the use of a scanning valve, as long as measurements are taken and recorded every minute.

Most high pressure test measurement points shall be plumbed together to a common test cabinet grouped by physical location.

Multiple pressures measured at different locations, but representing the same condition, shall be averaged together.

b. Temperature Measurements: All temperatures shall be measured using calibrated continuous lead, Type E (chromel constantan) thermocouples (T/Cs), or platinum resistance thermometers (RTDs) located in thermowells. T/Cs or RTDs are to use a cold junction electronic or real ice bath reference.

High precision temperature measurements are to be calibrated to within 0.5 F accuracy. Data collection intervals shall be one minute. All measured temperatures shall be corrected for instrumentation calibrations.

Thermalwells are to be brushed out to ensure no rust or residue exists. T/Cs or RTDs shall be spring loaded in the thermowell to ensure they are bottomed out. T/Cs or RTDs shall be packed with insulating sealer, not touching any metal lagging, and immersion depth recorded.

Multiple temperatures measured at different locations, but representing the same condition, shall be averaged together.

c. Flow Measurement: The differential pressure across the feed water flow nozzles shall be measured by duplicate 0.05 percent calibrated differential pressure transducers. All other subsidiary flowmeters shall be measured by single 0.1 percent calibrated differential pressure transducers.

Data collection intervals for the primary flow measurement shall be one-half minute. Data collection intervals for all other flow measurement shall be one minute. All measured differential pressures shall be corrected for static water legs, atmospheric pressure, and instrumentation calibrations. Multiple flows measured at different locations, but representing the same condition, shall be averaged together.

d. Electrical Load Measurement: The generator electrical load measurement shall be obtained using three (3) precision watthour meters and three calibrated (3) test potential transformers (having an accuracy of 0.25 percent), plus associated readout equipment. Indicating ammeters and voltmeters shall also be provided and connected to the secondary circuits for measurement. **OR** as an alternative, a modern, high-precision, digital, three-phase power meter may be used. The station's current transformers shall be used.

Data collection intervals for the electrical load measurement shall be every five minutes. Measurements shall be corrected for test equipment calibrations.

Test electrical measurement equipment shall be installed with the Unit off-line, therefore shall be shipped (in advance) and received the week prior to Unit startup.

e. Data Acquisition System: All output signals from pressure, temperature, and flow measurements shall be recorded automatically using a computer controlled data acquisition system.

Measurements shall be taken at the minimum requested time frequencies which are generally once per minute.

f. Station Instrumentation: IGS station instrumentation shall be utilized where there is no precision test instrumentation or test equipment.

IGS station instrumentation shall be cross referenced and reconciled with the precision instrumentation points.

9. Calibration of Test Instrumentation:

a. Third-party Instrumentation Calibrations: High accuracy pressure and differential pressure instrumentation shall be calibrated, before the tests using standards traceable to National Standards. Re-calibration following the test, shall take place if there is questionable data (due to discrepancies between station instrumentation or data that is out of line).

Temperature measurements shall be calibrated before the test and re-calibrated after the test to ensure accuracy. Pretest calibrations reports shall be submitted on test set-up. Post-test calibration reports shall be submitted within three (3) weeks after the test. Temperature calibrations shall be to a traceable National Bureau standard and include a minimum of five(5) test points at a minimum of two (2) immersion depths.

Electrical test instruments shall be calibrated before and immediately after the turbine test series, against secondary standards traceable to a recognized National standards laboratory under laboratory conditions that approximate the expected test site conditions.

10. Reports:

a. Report Information: The turbine generator test report shall include all relevant items as discussed in this contract including test results and conclusions, plus information as outlined in the ASME PTC 6, Section 6 - Report of Tests.

b. Rough Draft: A rough draft test report is due at the time of departure. This is to ensure all tests have good valid measurement points and results. Questionable or invalid data may justify rerunning a test. A preliminary test report is due within two (2) weeks after departure from the job site.

Copies of all pertinent test data, calibrations and preliminary calculations shall be left at the job site with the Contract Administrator before departure from the job site. All testing data shall be supplied in an Excel compatible file format.

c. Final Report: Three (3) copies of the final report shall be provided to IPSC within four (4) weeks following the tests.

11. Schedule: Testing for IGS Unit 2 shall be completed by May 31, 2002 (eight weeks after startup) and for IGS Unit 1 by May 30, 2003. This is an HP turbine contractual requirement.

a. Target test setup period is the week immediately following startup of the unit (startup for Unit 2 is targeted 03/31/02), but could begin as soon as the last week of the Outage. Test electrical measurement equipment must be installed with the Unit off-line, therefore must be shipped in advance and received by March 25, 2002.

b. Schedule Summary: IGS Unit 2

Performance Testing	April 8 - 13, 2002
Test Set-up (during Unit 2 shutdown):	April 1 - 6, 2002
HP Turbine Enthalpy Drop (30 day follow-up):	May 7 - 9, 2002

(HP Turbine contractual requirement, only if station instrumentation indicates a significant drop in performance.)

Schedule Summary: IGS Unit 1

Performance Testing	April 7 - 12, 2003
Test Set-up during Unit 2 shutdown	March 31 - April 5, 2003
HP Turbine Enthalpy Drop - 30 day followup	May 6 - 8, 2003

(HP Turbine contractual requirement, only if station instrumentation indicates a significant drop in performance.)

c. Benchmark Tests: Benchmark enthalpy drop tests shall be taken periodically with station instrumentation from the time of initial startup of the turbine and the results recorded for reference purposes.

12. Miscellaneous:

a. Cost Estimate: The Contractor shall provide an estimate of the total cost of identified scope of work, staffing schedule, and a required material and equipment list.

b. References: A list of references shall be provided listing previous test experience. This reference list is to include a utility contact name, phone number, where and when the test was conducted, and test methods used.

c. List of Contractor Property: The Contractor shall provide IPSC a list of instrumentation, tools, and materials brought onto the job site. A Property Removal Permit shall be required by IPSC whenever Contractor equipment is removed from the job site.

d. Drawings: IGS P&IDs shall be provided with test equipment locations marked and identifying locations of station instrumentation. IGS System Arrangement and Layout Drawings are available on request.

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Attachment I
LABOR RATE AND EXPENSE SHEET

The bidder shall complete this Labor Rate Sheet listing each category and level of labor likely to be utilized within this contract. Hourly Rates shall be provided for straight time, overtime, weekends and holidays for each category of manpower.

Labor Category	Straight Time Rate	Overtime/ Weekend Rate

Living expenses: All costs of residing near the power plant and transportation to and from the plant for purposes of work execution during scheduled work days shall be billed at the rate of $_____/day. This daily rate shall include, but not be limited to, room, board, phone, ground transportation, laundry and miscellaneous living expenses. Entertainment expenses shall not be included for reimbursement with living expense receipts.

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Attachment II
Test Instrumentation and Equipment List

Differential Pressure (Flow)		Instrumentation Range	Expected	Accuracy (%)
2	Final Feedwater (in-line flow nozzle)	100	53	0.05
2	BFPT Extraction Steam Flow (2) (in-line flow nozzles)	10	7.5	0.1
1	Main Steam Desuperheating Spray Flow (flow nozzle)	10	0.5	0.1
5	Total Differential Pressure Transducers			
		Instrumentation Range	Expected	Accuracy (%)
Pressure		psig or psia	psig or psia	Accuracy (%)
4	Main Steam/ Throttle	3000	2420	0.1
1	Steam Chest Press	3000	2390	0.1
1	Throttle (downstream CV)	3000	2340	0.1
2	Cold Reheat	1000	630	0.1
2	Hot Reheat	1000	585	0.1
3	LP Bowl (Crossover)	500	140	0.1
2	Top FW Heater- Extr Inlet (Htr 8A/ 8B- dual string)	3000	1085	0.1
2	Top FW Heater- Extr Inlet (Htr 7A/ 7B- dual string)	1000	615	0.1
2	BFPT Steam Inlet	500	140	0.1
2	BFPT Exhaust	5.0" Hga	3.7 "Hga	0.1
2	LP Turb Exhaust 1A (basket tips)	5.0" Hga	3.0 "Hga	0.1
2	LP Turb Exhaust 1B (basket tips)	5.0" Hga	2.3 "Hga	0.1
2	LP Turb Exhaust 1C (basket tips)	5.0" Hga	1.7 "Hga	0.1
1	Final Feedwater	3000	2690	0.1
2	BFP Inlet	500	315	0.1
2	BFP Discharge	3000	2990	0.1
32	Total Pressure Transducers			
		Instrumentation Range	Expected	Accuracy (%)
Temperature		F	F	F
4	Main Steam/ Throttle	1050	1005	0.5 F
4	Cold Reheat	750	660	0.5 F
4	Hot Reheat	1050	1005	0.5 F
3	LP Bowl- Crossover/ DA Extr	750	300	0.5 F
2	BFPTs Stm Inlet	750	300	0.5 F
2	Top FW Heater- Extr Inlet (Htr 8A/ 8B- dual string)	1050	810	0.5 F
2	Top FW Heater- Extr Inlet (Htr 7A/ 7B- dual string)	1050	800	0.5 F
2	Top FW Heater- Drain Outlet (Htr 8A/ 8B)	750	490	0.5 F
2	Top FW Heater- Drain Outlet (Htr 7A/ 7B)	750	410	0.5 F
2	Top FW Heater- Feedwater Inlet (Htr 8A/ 8B)	750	480	0.5 F
2	Top FW Heater- Feedwater Inlet (Htr 7A/ 7B)	750	400	0.5 F
2	Top FW Heater- Feedwater Outlet (Htr 8A/ 8B)	750	560	0.5 F
2	Top FW Heater- Feedwater Outlet (Htr 7A/ 7B)	750	480	0.5 F
1	Condensate Leaving Condenser	750	120	0.5 F
2	Final Feedwater	750	550	0.5 F
36	Total Temperature Instruments			
		Instrumentation Range	Expected	Accuracy (%)

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Electrical Power Measurement		Rating		
3	Potential Transducers	13800/ 120, 3000 VA, 60 Hz		0.25
3	Precision Watthour Meters	2.5 amp, 120 volt, 60 Hz		0.25
1	Indicating ammeters			
1	Indicating voltmeters			
8	Total Electrical Instruments			
OR	Digital 3 Phase Power Meter			0.25
Spares- Contractor shall provide adequate spares of test instrumentation, test equipment and parts in the event of poor agreement of redundant points, questionable data or instrument failure.				